



# Agenda

- Recap of Meeting 2
- Draft Benthic TMDLs
  - Bull Run
  - Popes Head Creek
  - South Run
- Next Steps



## Recap from Meeting 2

- Presented and discussed the stressor analysis methodology and reports for the Benthic TMDLs
- Presented and discussed the source assessment for the Bacteria TMDLS

# Three Segments Listed for Benthic Impairment

#### **Bull Run**

- **►VAN-A23R-01**
- Fairfax, Prince William
- ➤ 4.8 miles, from the confluence of Cub Run with Bull Run to the confluence of Popes Head Creek with Bull Run

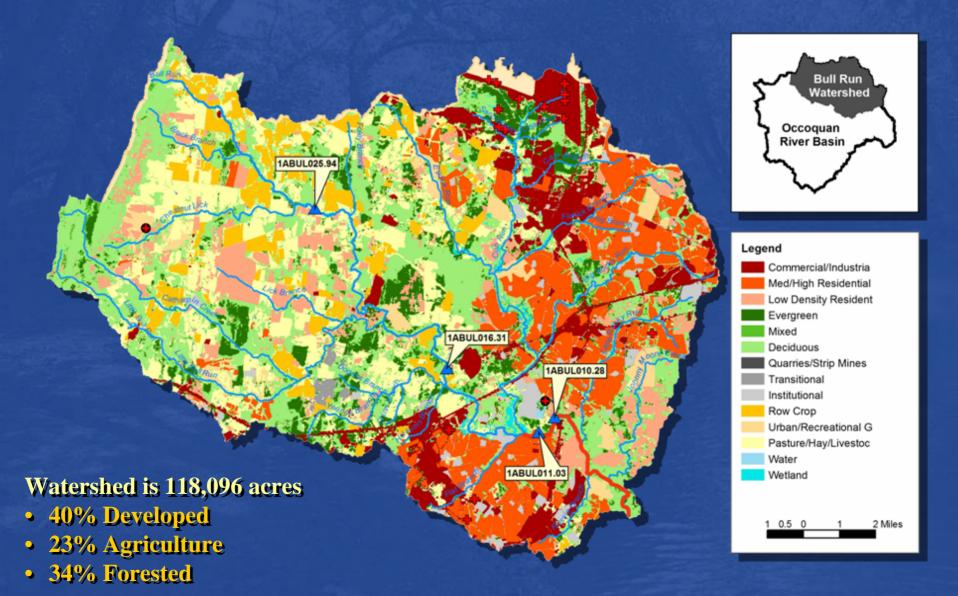
#### South Run

- > VAN-A19R-04
- > Fauquier, Prince William
- > 2.34 miles from Lake
  Brittle to the
  confluence of South
  Run with the
  inundated waters of
  Lake Manassas



# Bull Run

## Land Use in the Bull Run Watershed



### **Bull Run Watershed**

Individual VPDES Permitted Facilities - 9

- General Permits 116
  - 5 stormwater permits issued to individual facilities
  - 60 stormwater permits to construction\*
  - > 32 permits to domestic sewage facilities
  - > 11 permits issued to stormwater industrial sites
  - > 5 permits issued to concrete facilities
  - 3 permits issued to mines



\*Based on DCR Data

## Data Used in Stressor Identification

Agency/Group	Number of Sites	Number of Samples	Date Range Used	Data Type
Virginia Department of Environmental Quality	6	188	1994 - 2005	Ambient, Biological, Habitat
Occoquan Watershed Monitoring Lab	3	13,298	January 1994 - September 2004	Ambient, Flow
Fairfax County Stormwater Planning Division	5	7	1999, 2001	Biological
Fairfax County Health Department, Division of Environmental Health	12	6,962	January 1986 - December 2002	Chemical, Bacteria
Upper Occoquan Sewage Authority	2	36	January 2004 - September 2005	Ambient
Virginia Save Our Streams Program	9	21	March 2001 - July 2002	Biological, Habitat
Audubon Naturalist Society	7	99	1998 - 2002	Biological, Habitat
Discharge monitoring reports	3	174	February 2002 - June 2005	Discharge Monitoring

## **Stressor Analysis Conclusion**

- Most Probable Stressor: Sedimentation and Urban Runoff
- Observed biological impairment corresponds with an increase in impervious surfaces as the stream drains higher impervious areas from Cub Run, Big Rocky Run, and Little Rocky Run
- The increased imperviousness of urban areas results in less infiltration during precipitation events, and consequently a higher volume of runoff that enters the creek.
- Consequently, habitat assessment scores indicate that high runoff flows and stream bank erosion are the most probable stressors causing the habitat alterations in the Bull Run watershed

**Parameter** 

**Non-Stressors** 

Dissolved Oxygen

Temperature and pH

Metals and Organic Chemicals

**Nutrients** 

**Toxicity** 

**Possible Stressors** 

None

Most Probable stressors

Sedimentation and Urban Runoff

# Bull Run End point/ Numeric Target

# Reference Watershed Approach

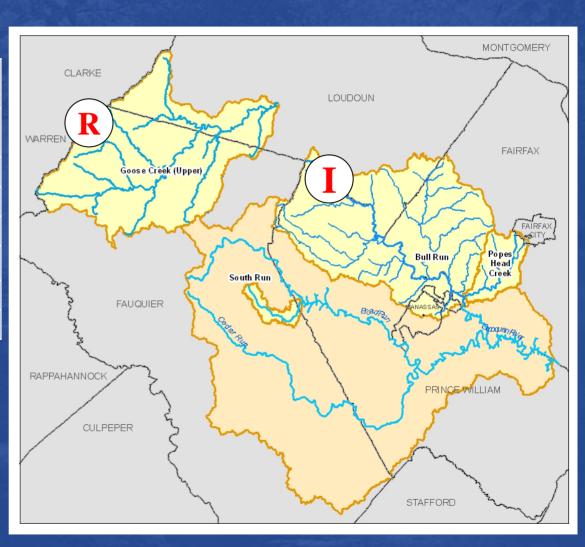
- The TMDL endpoint is established based on conditions in a similar, but non-impaired reference watershed.
- For benthic impairment caused by excessive sediment, the TMDL endpoint is the sediment loading rate in the non-impaired reference watershed.
- Reduction of the sediment loading in the impaired watershed to levels comparable to the reference watershed is assumed to be sufficient for recovery of the benthic community in the impaired watershed.

### Reference Watershed

- Goose Creek above DEQ monitoring station AGOO022.44
- Watershed is about 100,614 acres in area
- The Upper Goose Creek Watershed is not benthic impaired
- Is in the same ecoregion

## Reference Watershed

	% of Total Watershed			
Land Use Category	Bull Run	Goose Creek		
Forest	34	43		
Agricultural	23	55		
Developed	40	2		
Water/Wetlands	1	0		
Other	1	0		
Total	100	100		



# **RPII Score Comparison**

	SCI Scores				
Collection Period	Bull Run Impaired Stations			Reference Station	
	1ABUL009.61	1ABUL010.28	1ABUL011.12	1AGOO022.44 <sup>2</sup>	
Spring 1994	图 医医腹 基	56.9			
Fall 1994		55.6			
Spring 1995	William San	62		#1567 / SEE	
Fall 1995		54.6		1847 J. 1999	
Spring 1996	TO WATE OF	42.1		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Fall 1996	-	55.8			
Spring 1997		59.9	W. Carlot	No.	
Fall 1997	No. of the last of	50.8	VIII (MALES)		
Spring 1998		63			
Fall 1998	4 - ·				
Spring 1999	-	48.3			
Fall 1999		48.8	T	事 法自身	
Spring 2000		42.9		The state of	
Fall 2000	The same of the sa	60.5		1 - The state of t	
Spring 2004	-	40.2		67.6	
Fall 2004	4-1	57.2		62.6	
Spring 2005	36.57	- 10.00	56.83	67.5	
Average	36.57	53.2	56.83	65.1	

2: Monitoring station 1AGOO022.44 served as the Bull Run reference station for 2004

# Bull Run Sediment Loads

## Sediment Sources

- Sediment can be delivered to the stream from <u>point sources</u> located in the watershed and it can be carried in the form of <u>nonpoint source runoff</u> from non-vegetated or protected land areas.
- Sediment can be generated in the stream through the processes of scour and deposition which are primarily a function of stream flow. During periods of high flow, erosion of the stream channel occurs. The eroded materials are deposited downstream as stream flow decreases.
- These processes adversely impact the benthic macroinvertebrate community through loss of habitat and degradation of water quality.

# Source Loading Estimates

- 1. Identify potential sources
- 2. Calculate the point source, nonpoint source (land based) loads and the instream load from streambank erosion.
- 3. The sum of all the individual sources is the total load.
- 4. Load Calculation Process:
  - 1. Reference Watershed loading
  - 2. Adjust the reference watershed load for size
  - 3. Bull Run Loading

### **Land Based Load**

- > GWLF: Generalized Watershed Loading Functions
- Time variable model that simulates sediment loadings on a watershed basis
- Estimates sediment loading from difference sources in the watershed
- > EPA approved approach
- ➤ Model simulations performed from 1994- 2004

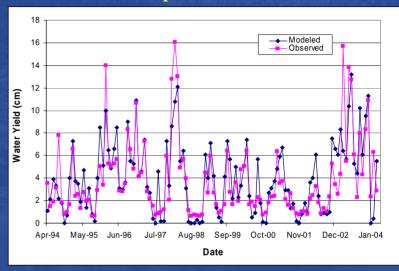
## **GWLF Input Parameters**

- > Weather data (UOSA 1993-2004)
- > Stream flow (OWML Station ST40)
- > Land use (NLCD, NVRC)
- > Curve runoff numbers (NRCS)
- > Soil parameters (STATSGO)

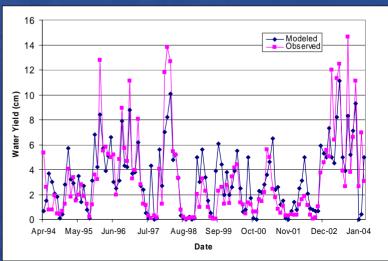
## **Model Calibration Results**

Calibration	Impaired	Reference
$\mathbb{R}^2$	0.700	0.671
% Error	7%	2%

#### **Impaired Watershed**



#### Reference Watershed



# Bull Run Annual Sediment Load from Land Sources

	Impaired Watershed	Reference Watershed	Adjusted Reference Watershed
Source	Sediment (tons/yr)	Sediment (tons/yr)	Sediment (tons/yr)
Transitional	339.0	55.6	62.0
Quarries/Strip Mine	0.0	0.0	0.0
<b>Deciduous Forest</b>	122.5	107.2	119.7
<b>Evergreen Forest</b>	27.7	4.2	4.7
Mixed Forest	17.1	65.5	73.1
Pasture/Hay/Livestock	2,179.4	6,923.9	7,26.1
Row Crop	4,479.6	459.9	513.2
Low intensity residential	6.4	0.6	0.6
Commercial/Industrial	411.5	15.3	17.0
Medium/High Residential	270.8	0.2	0.2
Institutional	43.2	0.0	0.0
<b>Urban/Recreational Grass</b>	1.3	0.0	0.0
Total	7,898.4	7,632.3	8,516.6

### Bull Run Annual Sediment Loads Instream Load

Watershed	Computed 'a' Factor	Instream Erosion (tons/yr)
Impaired Watershed	6.81E-04	38,480
Reference Watershed	8.14E-05	2,659
Reference Watershed (Area Adjusted)	8.14E-05	3,476

Estimated using the Evans et al. 2003 equation which relates the lateral erosion rate (LER) to flow (Q) using the equation:

$$LER = aQ^{0.6}$$

- > The 'a' factor is computed based on a wide variety of watershed parameters including:
  - the fraction of developed area of the watershed,
  - average field slope,
  - mean soil erodibility (K factor),
  - average curve number value, and
  - the mean livestock density for the watershed.
- Calculates sediment loading from instream (streambank) sources using land use, soils, physiographic, and flow information

### Bull Run Annual Sediment Loads Individual NPDES Permitted

#### **Bull Run Permitted Facilities:**

Facility Name	Permitted TSS Load (kg/day)	Annual Sediment Loading (ton/year)
UOSA	242.2	97.42
Golf Course	0.4	0.2
Sunoco	14.4	5.8
Total	257.0	103.4

#### Goose Creek Permitted Facilities:

Facility Name	Permitted TSS Load (kg/day)	Annual Sediment Loading (ton/year)
Foxcroft School	0.6	0.25
Middleburg WWTP	2.7	1.1
Notre Dame Academy	0.1	0.05
Total	3.5	1.4

<sup>\*</sup>Annual loading computed based on the facility design flow and permitted TSS concentration. Only these 3 facilities have a permit for TSS)

# Bull Run Annual Sediment Loads – Impaired vs. Reference Comparison

	Impaired Watershed	Reference Watershed	Adjusted Reference Watershed
Source	Sediment (tons/yr)	Sediment (tons/yr)	Sediment (tons/yr)
Transitional	339.0	55.6	62.0
Quarries/Strip Mine	0.0	0.0	0.0
Deciduous Forest	122.5	107.2	119.7
Evergreen Forest	27.7	4.2	4.7
Mixed Forest	17.1	65.5	73.1
Pasture/Hay/Livestock	2,179.4	6,923.9	7,726.1
Row Crop	4,479.6	459.9	513.2
Low intensity residential	6.4	0.6	0.6
Commercial/Industrial	411.5	15.3	17.0
Medium/High Residential	270.8	0.2	0.2
Institutional	43.2	0.0	0.0
Urban/Recreational Grass	1.3	0.0	0.0
Instream Erosion	38,480.6	2,659.2	3,476.2
<b>Point Sources</b>	103.4	1.4	1.4
Total	46,482.4	10,292.9	11,994.1

### TMDL End Point

- Reduction of the sediment loading in the impaired watershed to levels comparable to the reference watershed is assumed to be sufficient for recovery of the benthic community in the impaired watershed.
- Sediment load reduction and allocation
  - Nonpoint sources
  - >MS4
  - General permits

### Bull Run Total Average Annual Sediment Load All Sources (tons/year)

Source	Land Use Type	Existing Load (tons/year)	Allocated Load (tons/year)	Percent Reduction
	Deciduous Forest	56.5	56.5	0.0
	Evergreen Forest	12.8	12.8	0.0
	Mixed Forest	7.9	7.9	0.0
	Pasture/Hay	1,005.1	228.9	77.2
	Row Crop	2,065.9	470.5	77.2
	Quarries Strip Mine	0.0	0.0	77.2
Nonpoint Source	Transitional	339.0	77.3	77.2
	Low Intensity Residential	2.9	0.7	77.2
	Medium High Intensity	124.9	28.4	77.2
	Commercial/Industrial	189.9	43.2	77.2
	Institutional	19.9	4.5	77.2
	Urban Recreational Grass	0.6	0.1	77.2
	Instream Erosion	17,746.4	4,041.5	77.2
MS4	Nonpoint Source	4,249.0	979.8	77.0
11104	Instream Erosion	20,741.0	4782.9	77.0
Point Sources		103.4	103.4	0.0
Tota	al -	46,665.0	10,838.3	76.8

## MS4s in the Bull Run Watershed

- MS4 acreages were estimated using the Census Bureau data for urban areas and existing MS4 data for each jurisdiction.
- MS4 loads were estimated based on the simulated existing loads for the impaired watershed using GWLF (the percentage of sediment loading from each source- area attributed to the MS4s was proportional to the percentage of that source area in the Bull Run impaired watershed covered by the various MS4 permits).
- Instream erosion attributed to MS4 areas was estimated based on area weighted approach

# MS4 Existing Sediment Loads

MS4	Acres	Land-Based Loads (ton/year)	Instream Erosion (ton/year)	Total Load (tons/year)
Fairfax County	48,574.0	3,214.5	15,691.3	18,905.8
Fairfax City	167.0	11.1	53.9	65.0
Fairfax County Public Schools	309.8	20.5	100.1	120.6
NOVA Manassas Campus	91.0	6.0	29.4	35.4
Prince William County Public Schools	101.2	6.7	32.7	39.4
Loudoun County	5,126.0	339.2	1,655.9	1,995.1
Manassas City	2,401.0	158.9	775.6	934.5
Manassas Park	1,323.0	87.6	427.4	514.9
Prince William County	6,113.0	404.5	1,974.7	2,379.3
Total	64,206.0	4,249.0	20,741.0	24,990.0

### **Bull Run MS4 Allocations\***

MS4	Existing Load (tons/year	Allocated Load (tons/year)
Fairfax County	18,905.8	4,359.7
Fairfax City	65.0	15.0
Fairfax County Public Schools	120.6	27.8
NOVA Manassas Campus	35.4	8.2
Prince William County Public Schools	39.4	9.1
Loudoun County	1,995.1	460.1
Manassas City	934.5	215.5
Manassas Park	514.9	118.7
Prince William County	2,379.3	548.7
Total	24,990.0	5,762.7

<sup>\*</sup>Includes general and individual permit allocations

# General Permit & Individual Permit Stormwater TMDL Allocations

- The TSS allocation for each permitted facility was calculated using a DEQ assigned TSS concentration and the corresponding runoff amount generated on the site based on the facility area or the facility discharge. The TSS allocated load for each permit type was calculated as follows:
  - For <u>individual permitted facilities</u> and <u>general stormwater permits issued to industrial facilities</u> the allocated load was calculated based on a TSS concentration of 100 mg/L, and 72.54 cm of runoff per year. The annual average runoff of 72.54 cm corresponds to an annual average rainfall of 40.8 inches (103.63 cm) and an industrial land cover with 70 percent imperviousness. <u>The facility area was assumed to be 5 acres for each facility</u>.
  - For general permits issued to domestic sewage facilities, the allocated load was calculated based on a TSS concentration of 30 mg/L and the discharge flow value.
  - For general permits issued to quarries/mines and concrete facilities, the allocated load was calculated based on a TSS concentration of 30 mg/L, and 45.9 cm of runoff per year. The facility area was assumed to be 5 acres for each facility.

# Stormwater Construction Permits Allocations

- The existing and allocated loads for the construction permits were estimated based on the loads from the transitional land-use category.
- In other words, the transitional land-use category is assumed to be entirely comprised of construction sites.

Land Use Type	Existing Load (tons/yr)	Allocated Load (tons/yr)	Percent Reduction
Transitional	339.0	77.3	77.3

# General and Individual Stormwater Permits Allocated Loads

Category	Number of Permits	Existing Load (ton/year)	Allocated Load (ton/year)
Individual Permits	5		8.1
Concrete Facilities	5		8.1
General Residences	32	4.5	0.74
Mine/Quarries	3	-19	0.92
Industrial Facilities	11	-	17.8
Construction Permits/ Transitional Land-use category	60	339.0	77.3

# Bull Run MS4 Permit Allocations Excluding the General and Individual Permits

MS4	Existing Load -ton/yr	Allocated Load- ton/yr
Fairfax County	18,622.4	4,295.1
Fairfax City	64.0	14.8
Fairfax County Public Schools	118.8	27.4
NOVA Manassas Campus	34.9	8.0
Prince William County Public Schools	38.8	8.9
Loudoun County	1,965.2	453.3
Manassas City	920.5	212.3
Manassas Park	507.2	117.0
Prince William County	2,343.6	540.5
Total	24,615.4	5,677.4

### Bull Run Total Average Annual Sediment Load All Sources (tons/year)

Source	Land Use Type	Existing Load (tons/year)	Allocated Load (tons/year)	Percent Reduction
	Deciduous Forest	56.5	56.5	0.0
	Evergreen Forest	12.8	12.8	0.0
	Mixed Forest	7.9	7.9	0.0
	Pasture/Hay	1,005.1	228.9	77.2
	Row Crop	2,065.9	470.5	77.2
	Quarries Strip Mine	0.0	0.0	77.2
Nonpoint Source	Transitional	339.0	77.3	77.2
	Low Intensity Residential	2.9	0.7	77.2
	Medium High Intensity	124.9	28.4	77.2
	Commercial/Industrial	189.9	43.2	77.2
	Institutional	19.9	4.5	77.2
	Urban Recreational Grass	0.6	0.1	77.2
	Instream Erosion	17,746.4	4,041.5	77.2
MS4	Nonpoint Source	4,249.0	970.0	77.2
	Instream Erosion	20,741.0	4735.0	77.2
Point Sources *		103.4	161.1	_
Tota		46,665.0	10,838.3	76.8

## Bull Run TMDL

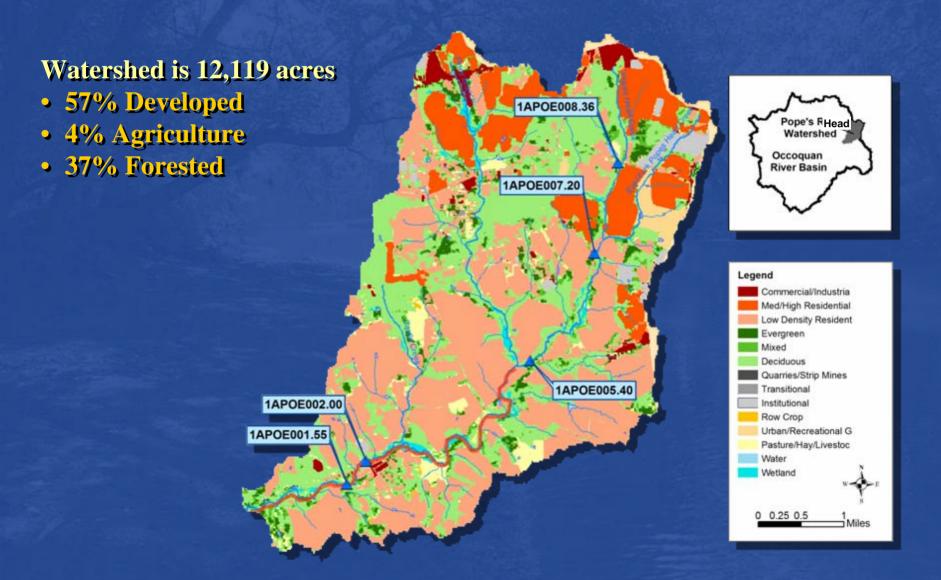
TMDL (tons/yr)	Load Allocation (tons/yr)	Wasteload Allocation (Point Source + MS4s) (tons/yr)	Margin of Safety (10%) (tons/yr)
11,994.1	4,928.7	5,866.0	1,199.4

## Bull Run TMDL Summary

- A TMDL allocation plan to meet and achieve the full support of aquatic life in Bull Run requires the following reductions in the sediment loads:
  - > 77.2% from agriculture, urban land uses (including MS4s), and instream erosion
  - 1% of the MS4 nonpoint source and instream erosion was set-aside to account for future growth in the watershed.

# Popes Head Creek

## Land Use: Popes Head Watershed



### Popes Head Creek Watershed

- No individual VPDES permitted facilities
- 7 active general permits
  - 3 permit issued to a domestic sewage facility
  - > 4 permits issued to a construction site



# Popes Head Creek Stressor Identification

### Data Used in Stressor Identification

Agency/Group	Number of Sites	Number of Samples	Date Range Used	Data Type
Virginia Department of Environmental Quality	5	95	1994 - 2005	Ambient, Biological, Habitat
Fairfax County Stormwater Planning Division	7	9	1999, 2001, 2004	Biological
Audubon Naturalist Society	5	53	1998 - 2002	Biological

## **Stressor Analysis Conclusion**

- Most Probable Stressor: Sedimentation and Urban Runoff
- In the Popes Head watershed, habitat assessment scores show poorer substrate embeddedness scores in the impaired segment suggesting the presence of increasing sediment loading
- Habitat metrics indicate a loss of riparian vegetation. The loss of riparian vegetation is usually caused by increased urbanization and impervious surfaces in the watershed.
- Urban land uses comprise 59 percent of the watershed. This level of urban land use suggests a high level of impervious surface area in the watershed, and increased runoff, elevated instream flow volumes, and increased channel erosion.

Parameter
Non-Stressors

Dissolved Oxygen

Temperature and pH

Metals

**Organics** 

**Possible Stressors** 

**Toxicity** 

Most Probable stressors

Sedimentation and Urban Runoff

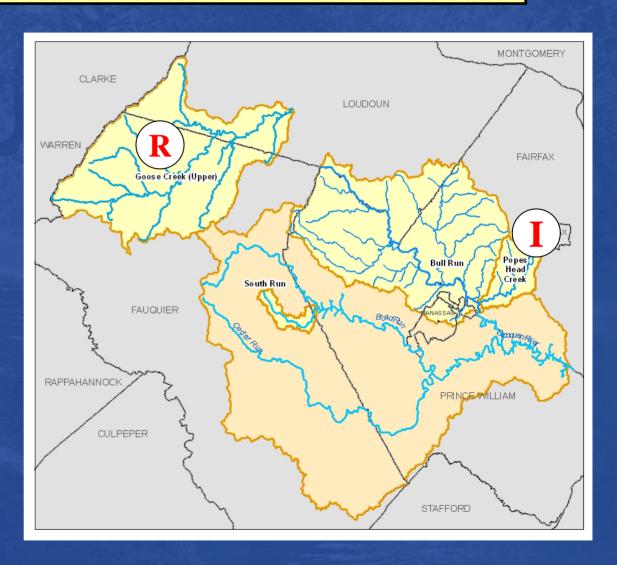
# Popes Head Creek End point/ Numeric Target

### Reference Watershed

- Goose Creek above DEQ monitoring station AGOO022.44
- Watershed is about 100,614 acres
- The watershed is not impaired
- Is in the same ecoregion

#### Reference Watershed

Land Use	% of Total Watershed		
Category	Goose Creek	Popes Head	
Forest	43	37	
Agricultural	55	4	
Developed	2	57	
Water/Wetlands	0	1	
Barren	0	0	
Total	100	100	



### **SCI Score Comparison**

		SCI Score
Collection Period	Impaired Station	Reference Station
	1APOE002.00	1AGOO022.44 <sup>2</sup>
Spring 1997	48.3	
Fall 1997	56.2	
Spring 1998	49.6	
Fall 1998	56.4	
Spring 1999	59	
Fall 1999	48.2	MARKET SE
Spring 2000	33.7	
Fall 2000		
Spring 2004	51.4	67.6
Fall 2004	48.2	62.6
Spring 2005	55	
Average	50.6	65.1

<sup>1:</sup> Monitoring station 1ACAX004.57 served as the reference station from 1994-2000

<sup>2:</sup> Monitoring station 1AGOO022.44 served as the reference station for 2004

# Popes Head Creek Sediment Loads

# **Total Sediment Loading**

The land based load modeled using GWLF
+

The instream load from streambank erosion

+

The load from point sources

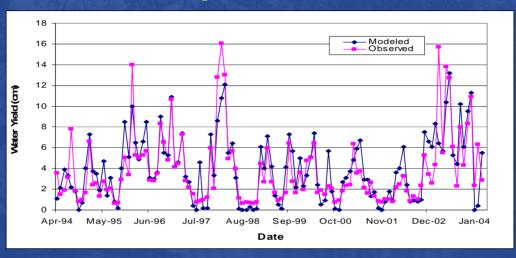
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The total sediment load in the Popes Head

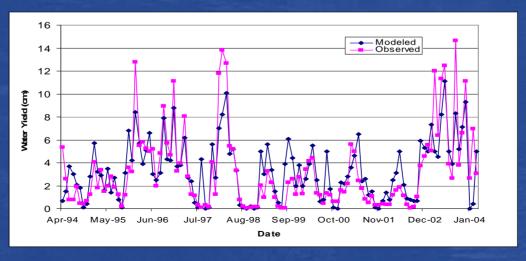
Creek Watershed

## Popes Head Creek Modeling Approach

#### Impaired Watershed



#### Reference Watershed



# Popes Head Creek Annual Sediment Load from Land Sources

	Impaired Watershed	Reference Watershed	Reference Watershed (Adjusted)
Source	Sediment (tons/yr)	Sediment (tons/yr)	Sediment (tons/yr)
Transitional	13.0	55.6	12.3
Quarries/Strip Mine	0.0	0.0	0.0
Deciduous Forest	28.2	107.2	23.6
Evergreen Forest	2.8	4.2	0.9
Mixed Forest	3.6	65.5	14.4
Pasture/Hay/Livestock	85.8	6,923.9	1,526.5
Row Crop	14.3	459.9	101.4
Low Intensity Residential	3.9	0.6	0.1
Commercial/Industrial	21.7	15.3	3.4
Medium/High Residential	45.9	0.2	0.0
Institutional	7.0	0.0	0.0
Urban/Recreational Grass	0.1	0.0	0.0
Total	226.4	7,632.3	1,682.7

### Popes Head Creek Annual Sediment Loads Instream Load

Watershed	Computed 'a' Factor	Instream Erosion (tons/yr)
Impaired Watershed	9.27E-04	1,982
Reference Watershed	8.14E-05	2,659
Reference Watershed (Area Adjusted)	8.14E-05	90

Estimated using the Evans et al. 2003 equation which relates the lateral erosion rate (LER) to flow (Q) using the equation:

$$LER = aQ^{0.6}$$

- The 'a' factor is computed based on a wide variety of watershed parameters including:
  - the fraction of developed area of the watershed,
  - awerage field slope.
  - mean soil erodibility (K factor),
  - awerage curve number value, and
  - the mean livestock density for the watershed.
- Calculates sediment loading from instream (streambank) sources using land use, soils, physiographic, and flow information

# Popes Head Creek Annual Sediment Loads Point Sources

Popes Head Permitted Facilities:

#### [No Individual NPDES Permitted Facilities]

#### Goose Creek Permitted Facilities:

Facility Name	Permitted TSS Load (kg/day)	Sediment Loading (ton/year)
Foxcroft School	0.6	0.25
Middleburg WWTP	2.7	1.1
Notre Dame Academy	0.1	0.05
Total	3.5	1.4

<sup>\*</sup>Annual loading computed based on the facility design flow and permitted TSS concentration.

## Popes Head Creek Annual Sediment Loads Impaired vs. Reference Comparison

	Impaired Watershed	Reference Watershed	Reference Watershed (Area Adjusted)
Source	Sediment (tons/yr)	Sediment (tons/yr)	Sediment (tons/yr)
Transitional	13.0	55.6	12.3
Quarries/Strip Mine	0.0	0.0	0.0
Deciduous Forest	28.2	107.2	23.6
Evergreen Forest	2.8	4.2	0.9
Mixed Forest	3.6	65.5	14.4
Pasture/Hay/Livestock	85.8	6,923.9	1,526.5
Row Crop	14.3	459.9	101.4
Low intensity residential	3.9	0.6	0.1
Commercial/Industrial	21.7	15.3	3.4
Medium/High Residential	45.9	0.2	0.0
Institutional	7.0	0.0	0.0
Urban/Recreational Grass	0.1	0.0	0.0
Instream Erosion	1,982.3	2,659.2	90.4
Point Sources	0.0	1.4	1.4
Total	2,208.7	10,291.5	1,773.1

### TMDL End Point

- Reduction of the sediment loading in the Popes Head impaired watershed to levels comparable to the reference watershed is assumed to be sufficient for recovery of the benthic community in the impaired watershed.
- Sediment load reduction and allocation
  - Nonpoint sources
  - >MS4
  - General Permits

# Popes Head Creek Total Average Annual Sediment Load All Sources (tons/year)

Source	Land Use Type	Existing Load (tons/yr)	Allocated Load (tons/yr)	Percent Reduction
	Deciduous Forest	0.61	0.61	0.0
	Evergreen Forest	0.06	0.06	0.0
	Mixed Forest	0.08	0.08	0.0
	Pasture/Hay	1.86	1.34	28.2
	Row Crop	0.31	0.22	28.2
1 1 N 40 1 RE	Quarries Strip Mine	0.00	0.0	0.0
Nonpoint Source	Transitional	13.0	9.35	28.2
	Low Intensity Residential	0.08	0.06	28.2
	Medium High Intensity	1.00	0.72	28.2
	Commercial/Industrial	0.47	0.34	28.2
	Institutional	0.15	0.11	28.2
	Urban Recreational Grass	0.003	0.00	28.2
	Instream Erosion	43.3	30.90	28.2
<b>Point Sources</b>	-	0.0	0.0	0.0
MS4	Nonpoint Source	221.5	160.0	27.7
1/154	Instream Erosion	1,939.3	1,401.1	27.7
Total		2,221.0	1604.9	27.8

# MS4s in Popes Head Creek

- MS4 acreages were estimated using the Census Bureau data for urban areas and existing MS4 data for each jurisdiction.
- MS4 loads were estimated based on the simulated existing loads for the impaired watershed (the percentage of sediment loading from each source- area attributed to the MS4s was proportional to the percentage of that source area in the Popes Head impaired watershed covered by the various MS4 permits).
- Instream erosion attributed to MS4 areas was estimate based on an area weighted approach.

# MS4s Existing Sediment Loads in Popes Head Creek

MS4 Area	Acres	Instream Erosion (ton/year)	Land Based (ton/year)	Total Load (ton/year)
Fairfax County	1,1603.0	1,899.2	2,16.9	2,116.1
Fairfax County Public Schools	77.8	12.7	1.5	14.2
Fairfax City	166.7	27.3	3.1	30.4
Total	11,847.5	1,939.3	221.5	2,160.7

<sup>\*</sup>Including general and individual permit allocations

# General Permit & Individual Permit Stormwater TMDL Allocations

- The TSS allocation for each permitted facility was calculated using a DEQ assigned TSS concentration and the corresponding runoff amount generated on the site based on the facility area or the facility discharge. The TSS allocated load for each permit type was calculated as follows:
  - For <u>individual permitted facilities</u> and <u>general stormwater permits issued to industrial facilities</u> the allocated load was calculated based on a TSS concentration of 100 mg/L, and 72.54 cm of runoff per year. The annual average runoff of 72.54 cm corresponds to an annual average rainfall of 40.8 inches (103.63 cm) and an industrial land cover with 70 percent imperviousness. <u>The facility area was assumed to be 5 acres for each facility</u>.
  - For general permits issued to domestic sewage facilities, the allocated load was calculated based on a TSS concentration of 30 mg/L and the discharge flow value.
  - For general permits issued to quarries/mines and concrete facilities, the allocated load was calculated based on a TSS concentration of 30 mg/L, and 45.9 cm of runoff per year. The facility area was assumed to be 5 acres for each facility.

# Stormwater Construction Permits Allocations

- The existing and allocated loads for the construction permits were estimated based on the loads from the transitional land-use category.
- In other words, the transitional land-use category is assumed to be entirely comprised of construction sites.

Land Use Type	Existing Load	Allocated load	Percent
	(ton/yr)	(ton/yr)	Reduction
Transitional	13.0	9.37	28.2

# Popes Head Creek Summary of Loads for General and Individual Stormwater Permits

Category	Number of Permits	Existing Load (Ton/Year)	Allocated Load (Ton/Year)
General Residences	3	THE N	0.05
Construction Sites/ Transitional Land-use category	4	0.28	0.20

# Popes Head Creek MS4 Permit Allocations Excluding the General and Individual Permits

MS4	Existing Loads (ton/year)	Allocated Loads (ton/year)
Fairfax County	2,115.8	1,528.7
Fairfax County Public Schools	14.2	10.3
Fairfax City	30.4	22.0
Total	2,160.4	1,560.9

# Popes Head Creek TMDL

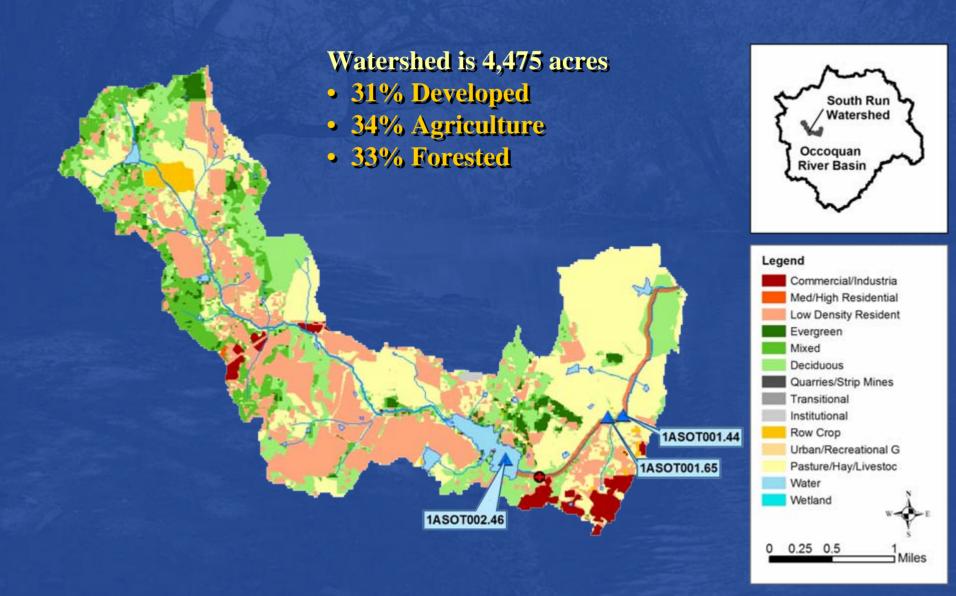
TMDL (tons/yr)	Load Allocation (tons/yr)	Wasteload Allocation (Point Source + MS4s) (tons/yr)	Margin of Safety (10%) (tons/yr)
1,773.1	34.6	1,561.1	177.3

### Pope Heads Creek TMDL Summary

- ➤ A TMDL allocation plan to meet and achieve the full support of aquatic life in Popes Head Creek requires the following reductions in the sediment loads:
  - > 28.2% from agriculture, urban land uses (including MS4s), and instream erosion

# South Run

## Land Use: South Run Watershed



# South Run Stressor Identification

### Data Used in Stressor Identification

Agency/Group	Number of Sites	Number of Samples	Date Range Used	Data Type
Virginia Department of Environmental Quality	3	125	1994 - 2005	Ambient, Biological, Habitat
Occoquan Watershed Monitoring Lab	3	1015	January 1994 - December 2004	Ambient, Flow
Discharge monitoring reports	1	77	February 1999 - June 2005	Discharge Monitoring

## **Stressor Analysis Conclusion**

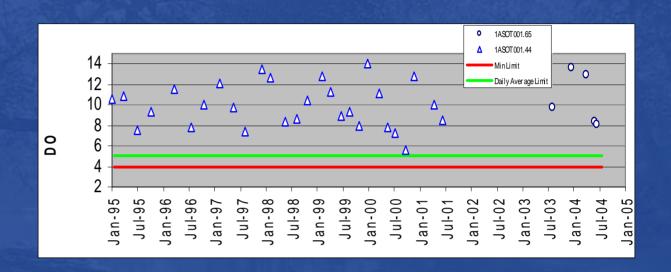
- Most Probable Stressor: Organic and nutrient enrichment
- Daily DO swings indicative of high levels of biotic production and the presence of eutrophication processes related to excessive nutrient loads were observed.
- This suggestion is supported by notes indicating the presence of excessive filamentous algae, which is commonly observed in streams with a high nutrient content (often from high nutrient content fertilizers).
- Organic enrichment in South Run is confirmed by a lower EPT taxa count and consistently high MFBI scores, which are indicative of a relatively tolerant community and of organic enrichment.

#### **Parameter** Non-Stressors Dissolved Oxygen Temperature and pH Metals **Organics Possible Stressors Toxicity Most Probable** stressors Organic and Nutrient Enrichment

# South Run End point/ Numeric Target

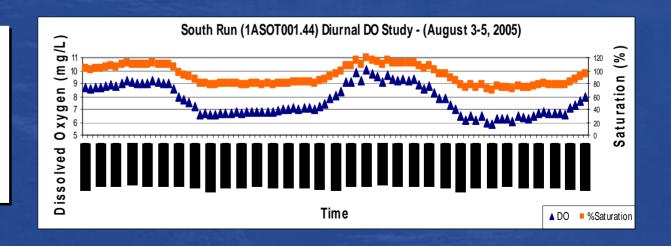
### Dissolved Oxygen in South Run

Ambient DO shows no exceedances of the minimum WQ Standard



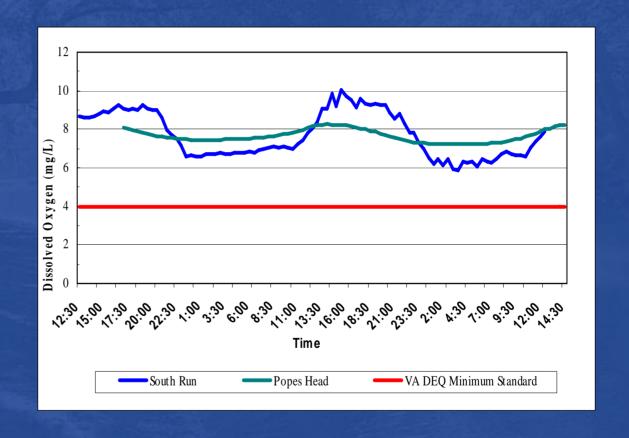
### **South Run Diurnal DO indicates:**

- •A very productive system
- •Daily DO range of 4 mg/L
- •Super-saturation of DO



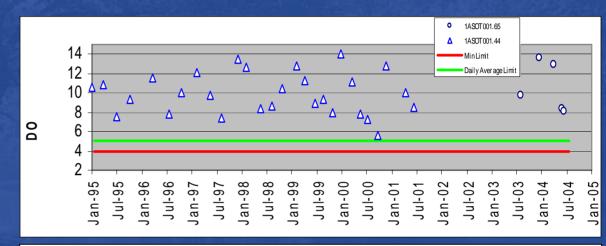
# Diurnal Dissolved Oxygen in Popes Head and South Run - August 2-3 2004

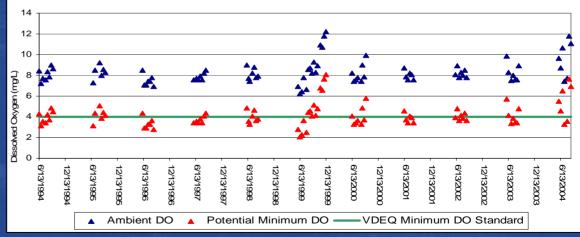
Diurnal DO variations in Popes Head show an adequate variation of 1 mg/L



#### Ambient Dissolved Oxygen and Potential Minimum DO in South Run (Summer Months)

- •Applying the diurnal fluctuations of 4 mg/L to the summer months ambient DO data indicates:
- DO fluctuations are a potential causing the potential DO to drop below the minimum standard
- The causes of these DO fluctuations is attributed to excessive nutrient (N, P) loadings



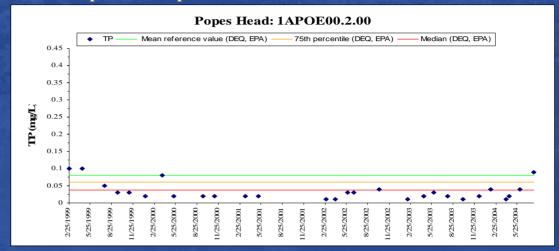


### **Nutrient TMDL End-Point**

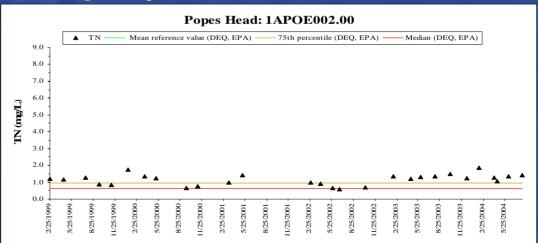
### No standard for nutrients

- Use a reference watershed approach
- Popes Head is proposed as a reference where TN & TP are within VADEQ/EPA nutrient reference values

#### Total Phosphorus in Popes Head Creek between 1999 and 2005



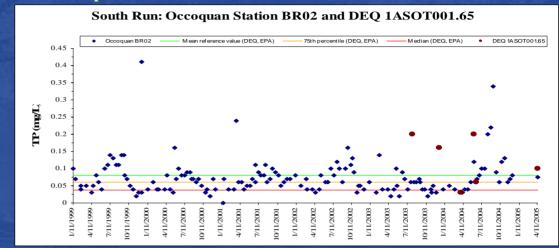
### Total Nitrogen in Popes Head Creek between 1999 and 2005



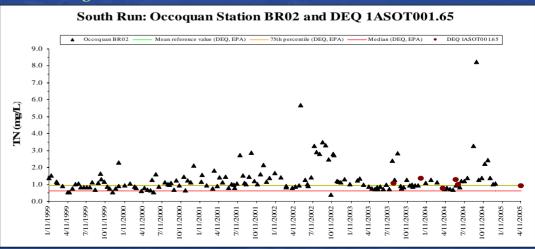
# Ambient Nutrient Observations in South Run

South Run ambient monitoring data indicates that nutrient concentrations frequently exceed the VADEQ/EPA reference values for phosphorus and nitrogen.

### Total Phosphorus in South Run Creek between 1999 and 2005



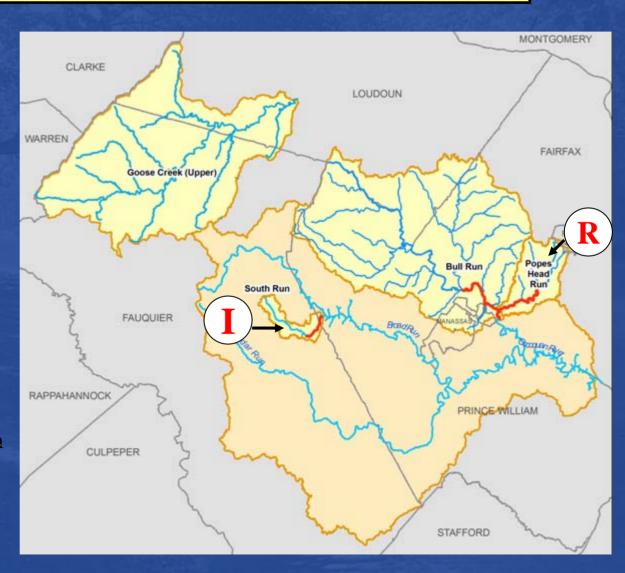
### Total Nitrogen in South Run Creek between 1999 and 2005



## Reference Watershed Selection

### Popes Head Creek Watershed

- Not impaired for nutrients
  - Has acceptable DO swings
  - Relatively low Phosphorus and Nitrogen concentrations
- No point sources present
- In the same ecoregion as South Run



# South Run Nutrient Loads

### Nutrient Sources

- Nutrients can be delivered to the stream from point sources located in the watershed and it can be carried in the form of nonpoint source runoff from agricultural as well as urban land uses.
- Nutrient enrichment adversely impacts the benthic macroinvertebrate community through loss of habitat and degradation of water quality.

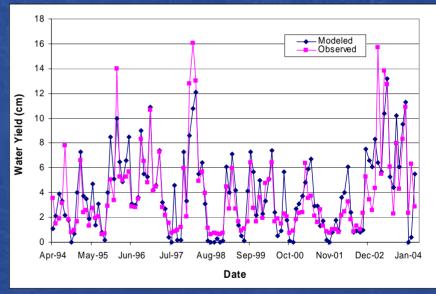
# Source Loading Estimates

- 1. Identify potential sources
- 2. Calculate the point source, nonpoint source (land based) loads
- 3. The sum of all the individual sources is the total load
- 4. Load Calculation Process:
  - 1. Reference Watershed loading
  - 2. Adjust the reference watershed load for size
  - 3. South Run Loading

## Modeling Approach

# Pollutant Load estimate needs to consider three components

- Land based load
  - GWLF Model
- > Point Sources
  - Permitted Loads
- Lake Brittle Load



Flow Used for Model: Bull Run

### Lake Brittle Contribution

- The Department of Game and Inland Fisheries (DGIF) conducted a nutrient study on Lake Brittle between October 1988 and September 1989. The study focused at the inlet and outlet of Lake Brittle (DGIF, 1989).
- DGIF concluded that "no increase in total phosphorus" was determined between the inlet and outlet of Lake Brittle. The phosphorus concentration was 0.1 mg/L for both the inlet and outlet.
- In addition, the water quality study concluded that Lake Brittle acts "as a phosphorus sink". Therefore, Lake Brittle does not have a significant impact on the total phosphorus concentration in South Run.

# South Run Nutrient Loading - Existing Condition

		T	Phosphorus otal Load (tons/y	r)	Nitrogen Total Load (tons/yr)		
Source	Land Use Type	Reference Watershed	Area-Adjusted Reference Watershed	Impaired Watershed	Reference Watershed	Area- Adjusted Reference Watershed	Impaired Watershed
	Transitional	0.01	0.00	0.00	0.03	0.01	0.00
	Quarries/Strip Mine	0.00	0.00	0.00	0.00	0.00	0.00
	Deciduous Forest	0.02	0.01	0.00	0.19	0.07	0.06
Literal Landson	Evergreen Forest	0.00	0.00	0.00	0.02	0.01	0.01
	Mixed Forest	0.00	0.00	0.00	0.02	0.01	0.02
Land Sources	Pasture/Hay/Livestock	0.06	0.02	0.209	1.05	0.37	4.11
Land Sources	Row Crop	0.01	0.00	0.044	0.03	0.01	0.17
	Low intensity residential	0.39	0.14	0.099	7.82	2.81	1.94
	Commercial/Industrial	0.11	0.03	0.044	1.06	0.37	0.45
	Medium/High Residential	0.62	0.22	0.00	3.50	1.26	0.01
	Institutional	0.08	0.02	0.00	0.30	0.11	0.01
	Urban/Recreational Grass	0.01	0.00	0.00	0.14	0.06	0.00
Groundwater		0.24	0.09	0.088	6.43	2.32	2.37
Septic System		0.01	0.01	0.011	1.65	1.65	1.60
Point Sources		0.00	0.00	0.173	0.00	0.00	2.10
	Total	1.54	0.56	0.668	22.23	9.05	12.83

## Endpoint for Nitrogen?

- > On average, N/P ratio is 18
  - Range between 11.6 and 25.5 between 1999 and 2004 based on Occoquan Lab Station BR02 data)
- Since N/P ratio is > 7.2, system is phosphorus limited
- Phosphorus controls the level of production in South Run
- Therefore, reduction of phosphorus will improve the water quality conditions and the benthic community in South Run

# South Run Total Maximum Daily Load (TMDL)

## **TP Load-Reduction Scenarios**

Since there is a plan to relocate the Vint Hill Farm discharge outfall, the following proposed TP load allocation scenarios will consider phosphorous load reduction from the point and nonpoint sources.

### Scenario 1: Existing Condition:

- NPS: concentration and flow are based on simulation results from GWLF.
- Point Source: Discharge effluent concentration is based on average DMR data and current design flow.

### Scenario 2:

- NPS: concentration and flow are based on simulation results from GWLF.
- Point Source: Discharge effluent concentration at 0.3 mg/L and current design flow.

### Scenario 3:

- NPS: concentration and flow are based on simulation results from GWLF.
- Point Source: Discharger outfall is relocated.

### Scenario 4: TMDL

- > NPS: concentration and flow are based on simulation results from GWLF.
- Point Source: Discharger outfall is relocated. However, some of the load is reserved for potential future growth.

# Comparison of Total Phosphorous Load to TMDL End-Point

	Point Source (ton/year)	NPS (ton/year)	Total Load (ton/year)	TMDL End-point (ton/year)	Difference (%)	
1	0.175	0.496	0.671 0.5058		+ 32.7	
2	0.113	0.393	0.609	0.5058	+ 20.4	
3		0.496	0.496	0.5058	- 2.0	
4	0.010	0.496	0.506	0.5058	0	

# Total Phosphorous Load Reductions

	Load (ton/year)		Total Load	Exceedances	
Scenario	PS	NPS	(ton/year)	(%)	
1	0.175	0.496	0.671	32.7	
2	0.113	0.393	0.506	0	
3	0.000	0.496	0.496	0	

Required Phosphorous Load Reduction to meet the TMDL Endpoint (%)								
PS	PS NPS							
0	0							
35.43	20.81							
100	0							

	TP Reduct	tion (%)	Load (ton/year)		Total Load <sup>1</sup> (ton/year)	Exceedances (%)
Scenario	PS	NPS	PS	NPS		(/•/
4 TMDL	2.0 % of LA	0.00	0.010	0.496	0.506	0.00

# Instream Total Phosphorous Concentration Under TMDL Scenarios

Scenario	Nonpoint Source <sup>1</sup>		oint Source <sup>1</sup> Point Source		Instream P (mg/l)	Tributary Strategy Phosphorous (mg/l)					
						Shenandoah		Ra	Rappahannock		
	mg/L	cfs	mg/L	MGD <sup>2</sup>	mg/L	Min	Mean	Max	Min	Mean	Max
13	0.053	9.58	1.59	0.072	0.070						
2	0.053	9.58	0.30	0.247	0.062	0.054	0.126	0.219	0.055	0.122	0.270
3	0.053	9.58		-	0.053						

<sup>&</sup>lt;sup>1</sup> Based on GWLF simulation results for South Run

Source: DEQ Freshwater Nutrient Criteria – Analysis of Downstream Effects, 2005.

<sup>&</sup>lt;sup>2</sup> Million Gallons per day

<sup>&</sup>lt;sup>3</sup> Existing condition: Average effluent concentration and discharge in 2004

# South Run TMDL

TMDL	Load Allocation (tons/yr)	Wasteload Allocation	Margin of Safety (10%)		
(tons/yr)		(tons/yr)	(tons/yr)		
0.562	0.496	0.010	0.056		

## South Run TMDL Summary

- ➤ A TMDL allocation plan to meet and achieve the full support of aquatic life in South Run requires the following reductions in the Total Phosphorous loads:
  - Relocation of the point source discharge outfall out of the South Run watershed while allocating 2.0% of the nonpoint source load to WLA to allow for potential future growth.

# Next Steps

- Draft TMDL Reports
- Public Comment period
- Respond to comments
- Final TMDL Reports
- Submit TMDL Reports to EPA

## Local TMDL Contacts



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